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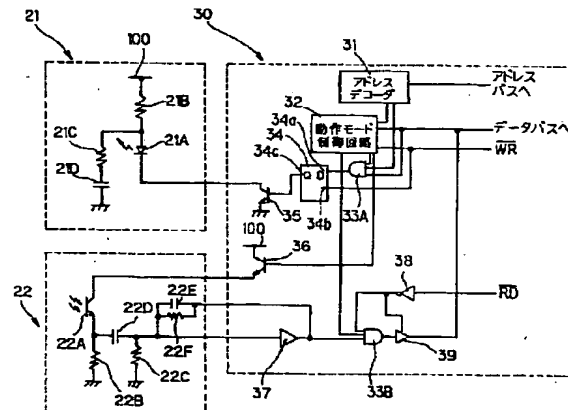
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(54) 【発明の名称】 光通信装置を備えたゲーム装置

(57) 【要約】

【課題】 使用電力に制限がある場合でも負荷を増大させることなく、発光側の作動初期の発光強度を大にして受信側の応答性、正確性を向上させることができる光送受信装置を備えたゲーム装置を提供する。

【解決手段】 発光部21に設けられるLED21Aと並列にコンデンサ21Dを設け、LED21Aの作動時に電源100に基づく注入電流とコンデンサ21Dに充電された電荷に基づく注入電流の和の注入電流を供給するようにした。



## 【特許請求の範囲】

【請求項 1】 プログラムの実行に基づいて外部機器に光信号を出射する発光器と、前記外部機器より出射される光信号を受光する受光器を有する光通信装置を備えたゲーム装置において、

前記発光器の非作動時に電源から供給される電荷を蓄積するコンデンサを有し、前記発光器の作動時に前記電源に基づく第 1 の注入電流と前記コンデンサの電荷に基づく第 2 の注入電流の和の注入電流を供給して前記発光器を作動させる発光回路と、

前記外部機器より出射される光信号の受光に基づいて発生する出力信号を読み取り信号に同期してリードする受光回路を備えたことを特徴とする光通信装置を備えたゲーム装置。

【請求項 2】 前記発光回路および前記受光回路は、第 1 の携帯型ゲーム装置に組み込まれており、前記外部機器は、前記発光回路および前記受光回路と同一の発光回路および受光回路を有する第 2 の携帯型ゲーム装置であり、

前記第 1 および第 2 の携帯型ゲーム装置は、一方の携帯型ゲーム装置の前記発光部ともう一方の携帯型ゲーム装置の前記受光部、および一方の携帯型ゲーム装置の前記受光部ともう一方の携帯型ゲーム装置の前記発光部が対向するように構成され、対向する発光部および受光部を近接して配置して光通信を行う構成の請求項第 1 項記載の光通信装置を備えたゲーム装置。

【請求項 3】 前記発光器および前記受光器は、プログラムおよびデータを格納する記憶素子を有する着脱可能なメモリカードに設けられる請求項第 1 項記載の光通信装置を備えたゲーム装置。

## 【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は光通信装置を備えたゲーム装置に関し、特に、使用電力に制限のある携帯型ゲーム装置間の光通信を可能とし、かつ、受信側の応答性、正確性に優れる光通信装置を備えたゲーム装置に関する。

【0002】

【従来技術】従来のゲーム装置として、携帯型ゲーム装置間で光信号を送受信することによりプログラムに基づくデータ通信を行うようにした光通信装置を備えたゲーム装置がある。

【0003】図 6 は、従来の光通信装置の発光部を示し、電源 55 に抵抗 56 を介して接続され、スイッチ 57 の ON/OFF に基づいて点灯する発光素子 (LED) 58 を有し、スイッチ 57 を ON することによって LED 58 が点灯する。LED 58 の点灯に基づいて出射される光信号は、他のゲーム装置の受光部 (図示せず) に入射して光電変換され、受光信号として出力される。

【0004】図 7 (a), (b) は、発光部および受光部に供給される電流と時間の関係を示し、時刻  $t_1$  において発光部を ON すると、LED 58 には図 7 (a) に示すように電源から注入電流  $I_1$  が供給される。一方、受光部は、LED 58 の発光に基づく光信号を受光することによって光電流を生じる。この光電流は図 7 (b) に示すように時刻  $t_1$  から上昇し、 $\Delta t$  秒後の時刻  $t_2$  に電流値  $I_2$  に達する。

【0005】

10 【発明が解決しようとする課題】しかし、従来の光通信装置によると、発光部で消費される電力を節約するために発光素子と直列に所定の値を有した抵抗を挿入しているので、発光素子を作動させても、発光素子に注入される電流のレベルは制限され、その結果、受光素子が十分な光量の光を受光するまで時間を要し、受信側の反応が不正確になる恐れがある。従って、本発明の目的は使用電力に制限がある場合でも負荷を増大させることなく、発光側の作動時の注入電流のレベルを大にして受信側の応答性、正確性を向上させることができる光通信装置を備えたゲーム装置を提供することにある。

【0006】

【課題を解決するための手段】本発明は上記した目的を実現するため、プログラムの実行に基づいて外部機器に光信号を出射する発光器と、前記外部機器より出射される光信号を受光する受光器を有する光通信装置を備えたゲーム装置において、前記発光器の非作動時に電源から供給される電荷を蓄積するコンデンサを有し、前記発光器の作動時に前記電源に基づく第 1 の注入電流と前記コンデンサの電荷に基づく第 2 の注入電流の和の注入電流を供給して前記発光器を作動させる発光回路と、前記外部機器より出射される光信号の受光に基づいて発生する出力信号を読み取り信号に同期してリードする受光回路を備えたゲーム装置を提供する。

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【0007】上記した光通信装置を備えたゲーム装置において、発光回路および受光回路は、第 1 の携帯型ゲーム装置に組み込まれており、外部機器は、発光回路および受光回路と同一の発光回路および受光回路を有する第 2 の携帯型ゲーム装置であり、第 1 および第 2 の携帯型ゲーム装置は、一方の携帯型ゲーム装置の発光部ともう一方の携帯型ゲーム装置の受光部、および一方の携帯型ゲーム装置の受光部ともう一方の携帯型ゲーム装置の発光部が対向するように構成され、対向する発光部および受光部を近接して配置することにより光通信を行う構成とすることが好ましい。また、発光器および受光器は、プログラムおよびデータを格納する記憶素子を有する着脱可能なメモリカードに設けることもできる。

【0008】

【発明の実施の形態】図 1 は、本発明の実施の形態における光通信装置を備えた携帯型ゲーム装置を示し、前面 50 に液晶ディスプレイ 11、十字キー 12、操作ボタン 1

3および14が配置された本体10と、本体10に着脱自在に装着されるメモリカード20を有し、メモリカード20の天面にはデータに基づく光信号の送受信を行う発光部21および受光部22が設けられている。

【0009】図2は、メモリカード20の制御ブロック図を示す。このメモリカード20は、各部の動作を制御する制御部30を有し、制御部30から出力される制御信号に基づいて光信号を発生するLED21A、受光した光信号を光強度に応じて光電変換するフォトリンジスタ22A、プログラムを格納したROM50、ゲーム実行中に発生するデータを格納するRAM51、本体10からメモリカード20を取り外したとき電池40からRAM51に電力を供給して格納されたゲームのデータを保護するリセット回路41、本体10に内蔵されてアドレス、データ、書き込み信号WRバー、読み込み信号RDバーを制御部30に入力するCPUα60を接続して構成されている。

【0010】図3は、メモリカード20の光通信部の回路図を示し、制御部30に発光部21と受光部22を接続して構成されている。

【0011】発光部21は、LED21A、抵抗21B、21C、およびコンデンサ21Dを有し、電源100に抵抗21Bを介して接続されるLED21Aは制御部30のトランジスタ35に接続されている。また、LED21Aと並列にコンデンサ21Dが抵抗21Cを介して接続されており、電源100の電力消費を節減するために抵抗21Bの抵抗値は抵抗21Cの抵抗値より大になるように設定されている。電源100は、制御部30によって「通信モード」が設定されるとトランジスタ35がONして通電する。

【0012】コンデンサ21Dは、LED21Aの点灯時の消灯時に電荷を充電し、トランジスタ35の導通時に電源に基づく注入電流と、コンデンサ21Dに充電された電荷に基づく注入電流の和の注入電流をLED21Aに供給する。

【0013】受光部22は、フォトリンジスタ22A、抵抗22B、22C、コンデンサ22D、22E、および抵抗22Fを有し、フォトリンジスタ22Aは制御部30のトランジスタ36と接続され、光電流-電圧変換用抵抗22Bを介して接地されている。また、抵抗22Bに並列に抵抗22Cがコンデンサ22Dを介して接続されている。コンデンサ22Dの出力端子は制御部30のアンプ37に接続されており、アンプ37に並列に抵抗22Fおよびコンデンサ22Eが接続されて帰還増幅回路を構成している。

【0014】制御部30は、アドレスデコーダ31、動作モード制御回路32、アンドゲート33A、33B、D-フリップフロップ34、トランジスタ35、36、アンプ37、インバータ38、バッファ39より構成されている。

【0015】アドレスデコーダ31は、動作モード制御回路32およびアンドゲート33Aと接続されている。動作モード制御回路32は、アンドゲート33A、33B、およびトランジスタ36と接続されている。アンドゲート33Aは、D-フリップフロップ34に接続されている。D-フリップフロップ34は、通信モード信号を入力するD端子34aと、書き込み信号WRバー（以下の説明では、単にWRとする）を入力するクロック端子34bと、D端子34aが「1」のとき「1」を出力し、D端子34aが「0」のとき「0」を出力するQ端子34cを有する。トランジスタ35は、D-フリップフロップ34のQ端子34cより「1」が出力されると導通状態となる。アンプ37は、フォトリンジスタ22Aで受光した光信号に基づく出力信号を増幅してアンドゲート33Bに入力する。インバータ38は、読み込み信号RDバー（以下の説明では、単にRDとする）を反転させた反転信号を発生する。バッファ39は、アンドゲート33Bを通過した出力信号を反転信号に同期してデータバスに出力する。

【0016】以上の構成において、2台の携帯型ゲーム装置間の光通信動作を説明する。2台の携帯型ゲーム装置を用意し、それぞれの本体10にメモリカード20を装着して電源をONにする。そして、前面に設けられた十字キー12および操作ボタン13、14を操作して「通信モード」を指令する。

【0017】次に、図4(a),(b)に示すように、2台のゲーム装置の本体10A（以下、ゲーム装置10Aという）および10B（以下、ゲーム装置10Bという）に装着されているメモリカード20の天面を対向させる。そして、ゲーム装置10A側の発光部21とゲーム装置10B側の受光部22、およびゲーム装置10A側の受光部22とゲーム装置10B側の発光部21が正対するように配置する。

【0018】このとき、メモリカード20の天面間の間隔Dが大であると、光信号を受光するフォトリンジスタ22Aの反応が不正確となるので近接させることが好ましく、あるいは天面同士を接触させても良い。

【0019】〔ゲーム装置10Aがゲーム装置10Bにデータを送信するとき〕制御部30のアドレスデコーダ31は、「通信モード」が指令されると、ゲーム装置10Aに内蔵されたCPUα60からアドレスバスを介してアドレス信号を入出力する。このアドレス信号はデコードされ、動作モード制御回路32に出力される。動作モード制御回路32は、アドレスデコーダ31からのデコード信号と、書き込み信号WRの「0」から「1」への変化（立ち上がり）を入力することによって、動作モード制御回路内に設けられた記憶装置に通信モードを記憶する。この記憶された通信モードを示す信号が、動作モード制御回路から「1」で出力され、アンドゲート33Aに入力される。この状態で、アンドゲート33A

に、CPU $\alpha 60$ から1ビットのデータと、アドレスデコーダからのデコード信号を入力することによって、アクティブ「1」になる。D-フリップフロップ34のD端子34aは、アンドゲート33Aの出力に接続されているので「1」になる。

【0020】D端子34aに「1」が入力しているとき、クロック端子34bに入力されている書き込み信号WRの「0」から「1」への変化に同期し、Q端子34cが「1」になると、トランジスタ35が導通し、LED21Aに注入電流が供給される。この注入電流は、電源100から供給される注入電流とコンデンサ21Dに充電された電荷に基づいて発生する注入電流の和の注入電流となるので、LED21Aは作動初期における発光強度が大になる。LED21Aの発光に基づく光信号 $L_1$ はメモリカード20Aの発光部21から出射される。

【0021】〔ゲーム装置10Aがゲーム装置10Bからデータを受信するとき〕制御部30のアドレスデコーダ31は、「通信モード」が指令されるとゲーム装置10Aに内蔵されたCPU $\alpha 60$ からアドレスバスを介してアドレス信号を入力する。このアドレス信号はデコードされて動作モード制御回路32に出力される。動作モード制御回路32は、アドレスデコーダ31からデコード信号を入力することによりアクティブとなる。このとき、読み取り信号RD（「0」信号）のインバータ38による反転信号（「1」信号）を入力することによってアンドゲート33Bをアクティブにし、かつ、トランジスタ36を導通させて受光部22に通電する。

【0022】メモリカード20Aの受光部22に光信号 $L_1$ が入射すると、フォトトランジスタ22Aで受光され、光強度に応じた受光信号に光電変換される。光電変換後の受光信号はアンプ37で増幅された後、アンドゲート33Bに入力する。アンドゲート33Bは増幅された受光信号を反転信号に同期してバッファ39に出力する。バッファ39に入力された受光信号は、読み取り信号RDの反転信号に同期してデータバスに出力される。

【0023】図5(a),(b)は、本発明の光通信装置の発光電流と受光電流の関係を示し、発光部21では、図5(a)に示すように、トランジスタ35の導通時（時刻 $t_1$ ）に、コンデンサ21Dに充電された電荷に基づく注入電流を電源からの注入電流に加えて供給するので、通常の発光電流 $I_{11}$ より大なる発光電流 $I_{11}'$ がLED21Aに供給される。このことにより作動初期の発光強度が瞬間的に大になる。コンデンサ21Dの放電後は通常の発光電流 $I_{11}$ となる。

【0024】受光部22では、図5(b)に示すように、LED21Aの作動初期に通常の発光強度に基づく受光電流 $I_{11}$ より大なる受光電流 $I_{11}'$ が発生するので、受光電流 $I_{11}$ が発生するまでの応答時間 $\Delta t$ （ $t_2 - t_1$ ）が小になり、かつ、受光電流 $I_{11}$ より大なるレベルの受光電流 $I_{12}'$ が発生し、反応が正確になる。

【0025】上記した光通信装置を備えたゲーム装置によると、2台の携帯型ゲーム装置を近接あるいは接触させて光通信を行うので、LEDの通常の発光強度を小にでき、電池の容量に基づいて使用電力に制限のある携帯型ゲーム装置でも光通信が可能になる。LEDは、作動初期に電源に基づく注入電流に加えてコンデンサに充電された電荷に基づく注入電流を供給されることによって、通常の発光強度より大なる発光強度の光信号を出射する。このことによりフォトトランジスタでは受光電流の立ち上がり時間が短くなり、大きなレベルの受光電流が発生し、確実な受光が行われる。また、「通信モード」の設定に基づいて受光回路に通電するようにしているので、電池の消耗が抑制されるとともに通電に伴って発生するノイズを低減することができる。

【0026】以上説明した光通信装置は、携帯型ゲーム装置に限定されず、他の端末同士の光通信に使用することも可能である。また、発光部および受光部を設ける場所についてもメモリカードに限定されず、例えば、携帯型ゲーム装置本体に設ける構成としても良い。

【0027】

【発明の効果】以上説明した通り、本発明の光通信装置を備えたゲーム装置によると、電源に基づく注入電流とコンデンサに充電された電荷に基づく注入電流の和の注入電流を作動時に供給される発光部と、光通信を行うときに通電される受光部を設けたため、使用電力に制限がある場合でも負荷を増大させることなく発光側の作動初期の光強度を大にして受信側の応答性、正確性を向上させることができる。

【図面の簡単な説明】

【図1】本発明の実施の形態における光通信装置を備えたゲーム装置を示す説明図である。

【図2】本発明の実施の形態における光通信装置を備えたゲーム装置の制御ブロック図である。

【図3】本発明の実施の形態における光通信装置を備えたゲーム装置の回路図である。

【図4】本発明の実施の形態における光通信装置の動作を示す説明図である。

【図5】(a)は、本発明の実施の形態における光通信装置の発光電流と時間の関係を示し、(b)は、受光電流と時間の関係を示す。

【図6】従来の光通信装置の発光回路を示す説明図。

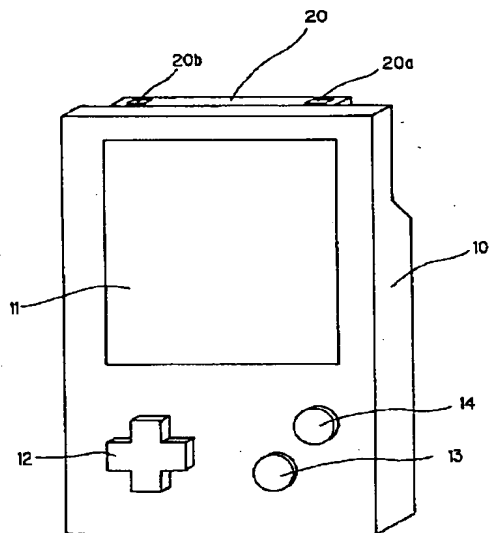
【図7】(a)は、従来の光通信装置の発生回路の発光電流と時間の関係を示し、(b)は、受光電流と時間の関係を示す。

【符号の説明】

- 10、本体
- 10A、本体
- 10B、本体
- 11、液晶ディスプレイ
- 12、十字キー

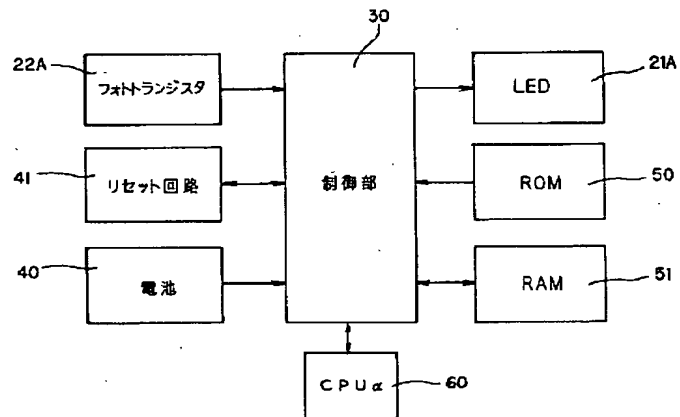
- 13, 操作ボタン
- 14, 操作ボタン
- 20, メモリカード
- 20A, メモリカード
- 20B, メモリカード
- 21, 発光部
- 21A, LED
- 21B, 抵抗
- 21C, 抵抗
- 21D, コンデンサ
- 22, 受光部
- 22A, フォトトランジスタ
- 22B, 抵抗
- 22C, 抵抗
- 22D, コンデンサ
- 22E, コンデンサ
- 22F, ディスプレイ
- 30, 制御部
- 31, アドレスデコーダ

【図1】

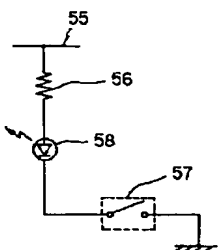


- \* 32, 動作モード制御回路
- 33A, アンドゲート
- 33B, アンドゲート
- 34, D-フリップフロップ
- 35, トランジスタ
- 36, トランジスタ
- 37, アンプ
- 38, インバータ
- 39, バッファ
- 10 40, 電池
- 41, リセット回路
- 50, ROM
- 51, RAM
- 55, 電源
- 56, 抵抗
- 57, スイッチ
- 58, LED
- 60, CPU $\alpha$
- \* 100, 電源

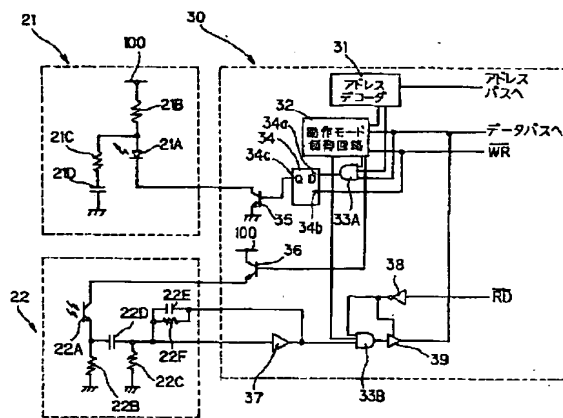
【図2】



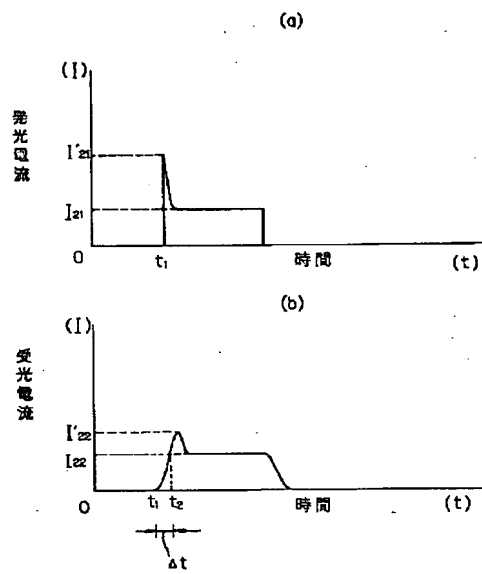
【図6】



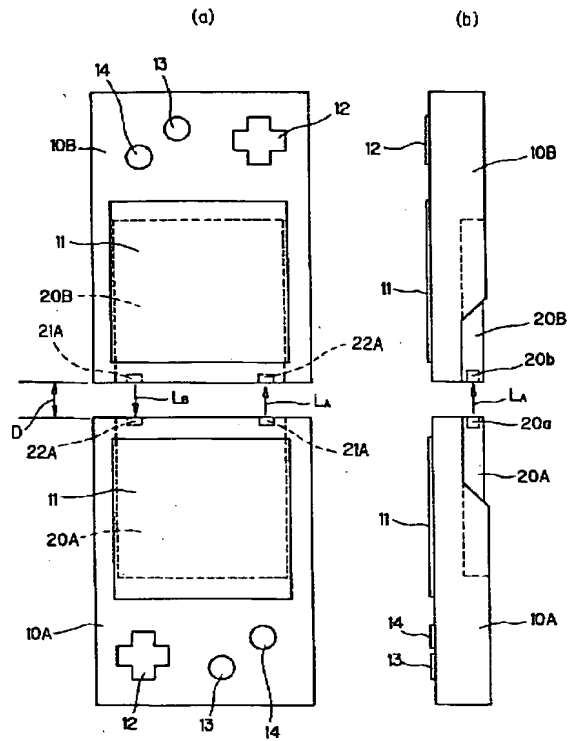
【図3】



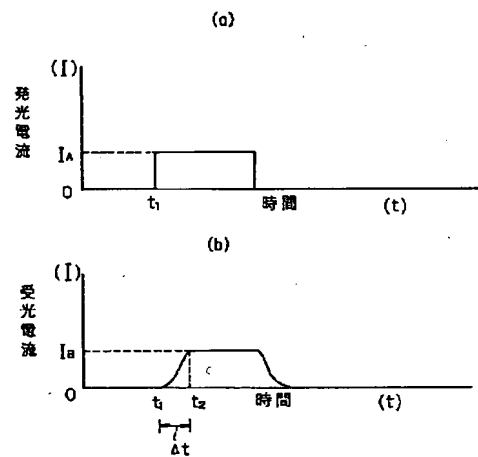
【図5】



【図4】



【図7】



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**Bibliography**

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(54) [Title of the Invention] Game equipment equipped with optical-communication equipment

(51) [International Patent Classification (6th Edition)]

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A63F 9/22 G

[Request for Examination] Un-asking.

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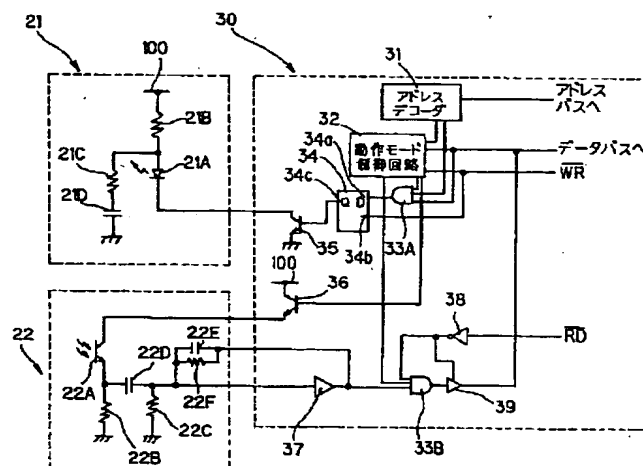
Summary

(57) [Abstract]

[Technical problem] Game equipment equipped with the optical transmitter-receiver which can make size luminescence intensity in early stages of [ operation ] a luminescence side, and can raise the responsibility of a receiving side and accuracy is offered without increasing a load, even when used power has a limit.

[Means for Solution] Capacitor 21D is prepared in parallel with Light Emitting Diode 21A prepared in a light-emitting part 21, and the inrush current based on a power supply 100 and the inrush current of the sum of the inrush current based on the charge charged by capacitor 21D were supplied at the time of the operation of Light Emitting Diode 21A.

[Translation done.]





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**CLAIMS**

[Claim(s)]

[Claim 1] The photogenic organ which carries out outgoing radiation of the lightwave signal to an external instrument based on program execution Optical-communication equipment which has the electric eye which receives the lightwave signal by which outgoing radiation is carried out from the aforementioned external instrument Are game equipment equipped with optical-communication equipment equipped with the above, and it has the capacitor which accumulates the charge supplied from a power supply at the time of un-operating [ of the aforementioned photogenic organ ]. The luminescence circuit which the 1st inrush current based on the aforementioned power supply and the inrush current of the sum of the 2nd inrush current based on the charge of the aforementioned capacitor are supplied [ circuit ] at the time of the operation of the aforementioned photogenic organ, and operates the aforementioned photogenic organ, It is characterized by having the light-receiving circuit which reads the output signal generated based on light-receiving of a lightwave signal by which outgoing radiation is carried out from the aforementioned external instrument, and is led synchronizing with a signal.

[Claim 2] The aforementioned luminescence circuit and the aforementioned light-receiving circuit are included in the 1st carried type game equipment. the aforementioned external instrument It is the 2nd carried type game equipment which has the same luminescence circuit as the aforementioned luminescence circuit and the aforementioned light-receiving circuit, and a light-receiving circuit. the above 1st and the 2nd carried type game equipment The aforementioned light-emitting part of one carried type game equipment, and the aforementioned light sensing portion of another carried type game equipment, And game equipment equipped with the optical-communication equipment of composition of being constituted, approaching, arranging the light-emitting part and light sensing portion which counter, and performing optical communication so that the aforementioned light sensing portion

of one carried type game equipment and the aforementioned light-emitting part of another carried type game equipment may counter given in the 1st term of a claim. [Claim 3] The aforementioned photogenic organ and the aforementioned electric eye are game equipment equipped with the optical-communication equipment given in the 1st term of a claim prepared in the removable memory card which has the storage element which stores a program and data.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to game equipment equipped with the optical-communication equipment which makes possible optical communication between the carried type game equipment which has a limit in used power especially about game equipment equipped with optical-communication equipment, and is excellent in the responsibility of a receiving side, and accuracy.

[0002]

[Description of the Prior Art] There is game equipment equipped with the optical-communication equipment which was made to perform data communication based on a program by transmitting and receiving a lightwave signal between carried type game equipment as conventional game equipment.

[0003] The light-emitting part of conventional optical-communication equipment is shown, it connects with a power supply 55 through resistance 56, drawing 6 has the light emitting device (Light Emitting Diode) 58 turned on based on ON/OFF of a switch 57, and Light Emitting Diode 58 turns it on by turning on a switch 57.

Incidence of the lightwave signal by which outgoing radiation is carried out based on lighting of Light Emitting Diode 58 is carried out to the light sensing portion (not shown) of other game equipments, and photo electric translation is carried out to it,

and it is outputted as a light-receiving signal.

[0004] Drawing 7 (a) and (b) The relation of the current and time which are supplied to a light-emitting part and a light sensing portion is shown, and it is time  $t_1$ . When it sets and a light-emitting part is turned on, in Light Emitting Diode 58, it is drawing 7 (a). It is a power supply to the inrush current  $I_A$  so that it may be shown. It is supplied. On the other hand, a light sensing portion produces a photocurrent by receiving the lightwave signal based on luminescence of Light Emitting Diode 58. this photocurrent — drawing 7 (b) it is shown — as — time  $t_1$  from — going up — time  $t_2$  — second after delta Current value  $I_B$  It reaches.

[0005]

[Problem(s) to be Solved by the Invention] However, since according to conventional optical-communication equipment resistance with the predetermined value is inserted in a light emitting device and a serial in order to save the power consumed with a light-emitting part, even if it operates a light emitting device, the level of the current poured into a light emitting device takes time to be restricted, consequently for a photo detector to receive the light of sufficient quantity of light, and has a possibility that the reaction of a receiving side may become inaccurate. Therefore, the purpose of this invention is to offer game equipment equipped with the optical-communication equipment which can make size level of the inrush current at the time of the operation by the side of luminescence, and can raise the responsibility of a receiving side, and accuracy, without increasing a load, even when used power has a limit.

[0006]

[Means for Solving the Problem] In game equipment equipped with the optical-communication equipment which has the photogenic organ which carries out outgoing radiation of the lightwave signal to an external instrument based on program execution, and the electric eye which receives the lightwave signal by which outgoing radiation is carried out from the aforementioned external instrument in order that this invention may realize the above-mentioned purpose It has the capacitor which accumulates the charge supplied from a power supply at the time of un-operating [ of the aforementioned photogenic organ ]. The luminescence circuit which the 1st inrush current based on the aforementioned power supply and the inrush current of the sum of the 2nd inrush current based on the charge of the aforementioned capacitor are supplied [ circuit ] at the time of the operation of the aforementioned photogenic organ, and operates the aforementioned photogenic organ, Game equipment equipped with the light-receiving circuit which reads the output signal generated based on light-receiving of a lightwave signal by which outgoing radiation is carried out from the aforementioned external instrument, and is led synchronizing with a signal is offered.

[0007] In game equipment equipped with the above-mentioned optical-communication equipment a luminescence circuit and a light-receiving circuit It is included in the 1st carried type game equipment. an external instrument It is the 2nd

carried type game equipment which has the same luminescence circuit as a luminescence circuit and a light-receiving circuit, and a light-receiving circuit. the 1st and 2nd carried type game equipment The light-emitting part of one carried type game equipment, and the light sensing portion of another carried type game equipment, And considering as the composition which performs optical communication is desirable by approaching and arranging the light-emitting part and light sensing portion which are constituted and counter so that the light sensing portion of one carried type game equipment and the light-emitting part of another carried type game equipment may counter. Moreover, a photogenic organ and an electric eye can also be prepared in the removable memory card which has the storage element which stores a program and data.

[0008]

[Embodiments of the Invention] Drawing 1 shows carried type game equipment equipped with the optical-communication equipment in the form of operation of this invention, and has the memory card 20 with which the main part 10 with which a liquid crystal display 11, the cross-joint key 12, and the operation buttons 13 and 14 have been arranged in the front face, and a main part 10 are equipped free [ attachment and detachment ], and the light-emitting part 21 and light sensing portion 22 which transmit and receive the lightwave signal based on data are prepared in the top panel of memory card 20.

[0009] Drawing 2 shows the control-block view of memory card 20. This memory card 20 has the control section 30 which controls operation of each part. Light Emitting Diode21A which generates a lightwave signal based on the control signal outputted from a control section 30, Photo transistor 22A which carries out photo electric translation of the lightwave signal which received light according to optical intensity, When memory card 20 is removed from ROM50 which stored the program, RAM51 which stores the data generated during game execution, and a main part 10 CPUalpha60 which are built in the reset circuit 41 and main part 10 which protect the data of the game stored in RAM51 by supplying power from a cell 40, and input the address, data, a write-in signal WR bar, and a reading signal RD bar into a control section 30 are connected, and it is constituted.

[0010] Drawing 3 shows the circuit diagram of the optical-communication section of memory card 20, connects a light-emitting part 21 and a light sensing portion 22 to a control section 30, and is constituted.

[0011] A light-emitting part 21 has Light Emitting Diode21A, Resistance 21B and 21C, and capacitor 21D, and Light Emitting Diode21A connected to a power supply 100 through resistance 21B is connected to the transistor 35 of a control section 30. Moreover, in parallel with Light Emitting Diode21A, capacitor 21D is connected through resistance 21C, and in order to reduce the power consumption of a power supply 100, the resistance of resistance 21B is set up so that it may become size from the resistance of resistance 21C. If the "communicate mode" is set up by the control section 30, a transistor 35 will turn on and energize a power supply 100.

[0012] Capacitor 21D charges a charge at the time of putting out lights during lighting of Light Emitting Diode 21A, and supplies the inrush current based on a power supply, and the inrush current of the sum of the inrush current based on the charge charged by capacitor 21D to Light Emitting Diode 21A at the time of the flow of a transistor 35.

[0013] A light sensing portion 22 has photo transistor 22A, Resistance 22B and 22C, Capacitors 22D and 22E, and resistance 22F, it connects with the transistor 36 of a control section 30, and photo transistor 22A is grounded through resistance 22B for photocurrent-voltage conversion. Moreover, resistance 22C is connected through capacitor 22D in parallel with resistance 22B. It connects with the amplifier 37 of a control section 30, resistance 22F and capacitor 22E is connected in parallel with amplifier 37, and the output terminal of capacitor 22D constitutes the feedback amplifier.

[0014] The control section 30 consists of an address decoder 31, the mode-of-operation control circuit 32, AND gates 33A and 33B, the D-flip-flop 34, transistors 35 and 36, amplifier 37, an inverter 38, and a buffer 39.

[0015] The address decoder 31 is connected with the mode-of-operation control circuit 32 and AND-gate 33A. The mode-of-operation control circuit 32 is connected with AND gates 33A and 33B and the transistor 36. AND-gate 33A is connected to the D-flip-flop 34. The D-flip-flop 34 outputs "1", when D terminal 34a which inputs a communicate mode signal, clock terminal 34b which inputs a write-in signal WR bar (only referred to as WR in the following explanation), and D terminal 34a are "1", and when D terminal 34a is "0", it has Q terminal 34c which outputs "0." A transistor 35 will be in switch-on, if "1" is outputted from Q terminal 34c of the D-flip-flop 34. Amplifier 37 amplifies the output signal based on the lightwave signal which received light by photo transistor 22A, and inputs it into AND-gate 33B. An inverter 38 generates the reversal signal which reversed the reading signal RD bar (only referred to as RD in the following explanation). A buffer 39 outputs the output signal which passed AND-gate 33B to a data bus synchronizing with a reversal signal.

[0016] In the above composition, optical-communication operation for two sets of carried type game equipments is explained. Two sets of carried type game equipments are prepared, each main part 10 is equipped with memory card 20, and a power supply is turned ON. And the cross-joint key 12 and the operation buttons 13 and 14 which were prepared in the front face are operated, and it is ordered the "communicate mode."

[0017] Next, drawing 4 (a) and (b) The top panel of the memory card 20 with which the main parts 10A (henceforth game equipment 10A) and 10B (henceforth game equipment 10B) of two sets of game equipments are equipped is made to counter so that it may be shown. And it arranges so that the light-emitting part 21 by the side of game equipment 10A, the light sensing portion 22 by the side of game equipment 10B and the light sensing portion 22 by the side of game equipment 10A, and the

light-emitting part 21 by the side of game equipment 10B may carry out a right pair.

[0018] At this time, it may be desirable to make it approach, since the reaction of photo transistor 22A which receives a lightwave signal as the interval D between the top panels of memory card 20 is size becomes inaccurate, or it may contact top panels.

[0019] [Time of game equipment 10A transmitting data to game equipment 10B If ordered the address decoder 31 of a control section 30 in the "communicate mode", it will output from CPUalpha60 built in game equipment 10A and input an address signal through an address bus.] This address signal is decoded and is outputted to the mode-of-operation control circuit 32. The mode-of-operation control circuit 32 memorizes the communicate mode to the storage formed in the mode-of-operation control circuit by inputting the change (standup) to "1" of the decoding signal from an address decoder 31, and the write-in signal WR from "0." The signal which shows this memorized communicate mode is outputted by "1" from a mode-of-operation control circuit, and is inputted into AND-gate 33A. active by inputting the decoding signal from an address decoder into AND-gate 33A as CPUalpha60 to 1-bit data in this state -- it is set to "1" Since it connects with the output of AND-gate 33A, D terminal 34a of the D-flip-flop 34 is set to "1."

[0020] If it synchronizes with the change to "1" of the write-in signal WR inputted into clock terminal 34b from "0" and Q terminal 34c is set to "1" when "1" has inputted into D terminal 34a, a transistor 35 will flow and an inrush current will be supplied to Light Emitting Diode21A. Since this inrush current turns into an inrush current supplied from a power supply 100, and an inrush current of the sum of the inrush current generated based on the charge charged by capacitor 21D, luminescence intensity [ in / the early stages of an operation / in Light Emitting Diode21A ] becomes size. Lightwave signal LA based on luminescence of Light Emitting Diode21A Outgoing radiation is carried out from the light-emitting part 21 of memory card 20A.

[0021] [Time of game equipment 10A receiving data from game equipment 10B] If ordered the address decoder 31 of a control section 30 in the "communicate mode", it will input an address signal through an address bus from CPUalpha60 built in game equipment 10A. This address signal is decoded and is outputted to the mode-of-operation control circuit 32. The mode-of-operation control circuit 32 becomes active by inputting a decoding signal from an address decoder 31. At this time, by inputting the reversal signal ("1" signal) by the inverter 38 of the reading signal RD ("0" signals), make AND-gate 33B active, and it is made to flow through a transistor 36, and energizes to a light sensing portion 22.

[0022] It is a lightwave signal LB to the light sensing portion 22 of memory card 20A. If incidence is carried out, light will be received by photo transistor 22A, and photo electric translation will be carried out to the light-receiving signal according to optical intensity. After the light-receiving signal after photo electric translation is amplified with amplifier 37, it is inputted into AND-gate 33B. AND-gate 33B outputs

the amplified light-receiving signal to a buffer 39 synchronizing with a reversal signal. The light-receiving signal inputted into the buffer 39 is outputted to a data bus synchronizing with the reversal signal of the reading signal RD.

[0023] Drawing 5 (a) and (b) The relation between the luminescence current of the optical-communication equipment of this invention and light-receiving current is shown. in a light-emitting part 21 Drawing 5 (a) Since the inrush current based on the charge charged by capacitor 21D at the time of the flow of a transistor 35 (time  $t_1$ ) is added and supplied to an inrush current from a power supply so that it may be shown, luminescence current I21' which consists of usual luminescence current I21 size is supplied to Light Emitting Diode 21A. The luminescence intensity in early stages of an operation becomes size momentarily by this. After electric discharge of capacitor 21D serves as usual luminescence current I21.

[0024] At a light sensing portion 22, it is drawing 5 (b). Since light-receiving current I22' which becomes in early stages of [ operation ] Light Emitting Diode 21A from the light-receiving current I22 based on the usual luminescence intensity size occurs so that it may be shown Light-receiving current I22' of the level which response-time  $\Delta t$  ( $t_2 - t_1$ ) until light-receiving current I22 occurs becomes smallness, and consists of light-receiving current I22 size occurs, and a reaction becomes exact.

[0025] Since according to game equipment equipped with the above-mentioned optical-communication equipment two sets of carried type game equipments are approached or contacted and optical communication is performed, the usual luminescence intensity of Light Emitting Diode is made to smallness, and optical communication becomes possible also with the carried type game equipment which has a limit in used power based on the capacity of a cell. Light Emitting Diode carries out outgoing radiation of the lightwave signal of the luminescence intensity which consists of the usual luminescence intensity size by supplying the inrush current based on the charge which was charged by the capacitor in early stages of the operation in addition to the inrush current based on a power supply. By the photo transistor, the build up time of light-receiving current becomes short by this, the light-receiving current of big level occurs, and positive light-receiving is performed. Moreover, since it is made to energize in a light-receiving circuit based on a setup of the "communicate mode", while exhaustion of a cell is suppressed, the noise generated with energization can be reduced.

[0026] It is not limited to carried type game equipment, but the optical-communication equipment explained above can also be used for the optical communication of other terminals. Moreover, it is good also as composition which it is not limited to memory card about the place in which a light-emitting part and a light sensing portion are prepared, for example, is prepared in the main part of carried type game equipment.

[0027]

[Effect of the Invention] According to game equipment equipped with the optical-communication equipment of this invention, as explained above Since the light-

emitting part to which the inrush current of the sum of the inrush current based on a power supply and the inrush current based on the charge charged by the capacitor is supplied at the time of an operation, and the light sensing portion energized when performing optical communication were prepared, Without increasing a load, even when used power has a limit, optical intensity in early stages of [ operation ] a luminescence side can be made into size, and the responsibility of a receiving side and accuracy can be raised.

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] It is explanatory drawing showing game equipment equipped with the optical-communication equipment in the gestalt of operation of this invention.

[Drawing 2] It is the control-block view of game equipment equipped with the optical-communication equipment in the gestalt of operation of this invention.

[Drawing 3] It is the circuit diagram of game equipment equipped with the optical-communication equipment in the gestalt of operation of this invention.

[Drawing 4] It is explanatory drawing showing operation of the optical-communication equipment in the gestalt of operation of this invention.

[Drawing 5] (a) The luminescence current of optical-communication equipment and the relation of time to the gestalt of operation of \*\* and this invention are shown, and it is (b). The relation between light-receiving current and time is shown.

[Drawing 6] Explanatory drawing showing the luminescence circuit of conventional optical-communication equipment.

[Drawing 7] (a) The luminescence current of the generating circuit of \*\* and conventional optical-communication equipment and the relation of time are shown, and it is (b). The relation between light-receiving current and time is shown.

[Description of Notations]

10 Main part

10A, a main part



10B, a main part  
11 Liquid crystal display  
12, a cross-joint key  
13, an operation button  
14, an operation button  
20 Memory card  
20A, memory card  
20B, memory card  
21 Light-emitting part  
21A,LED  
21B, resistance  
21C, resistance  
21D, a capacitor  
22 Light sensing portion  
22A, a photo transistor  
22B, resistance  
22C, resistance  
22D, a capacitor  
22E, a capacitor  
22F, a display  
30 Control section  
31 Address decoder  
32, a mode-of-operation control circuit  
33A, an AND gate  
33B, an AND gate  
34, D-flip-flop  
35 Transistor  
36 Transistor  
37 Amplifier  
38 Inverter  
39 Buffer  
40 Cell  
41 Reset circuit  
50,ROM  
51,RAM  
55 Power supply  
56 Resistance  
57 Switch  
58,LED  
60 CPUalpha  
100 Power supply

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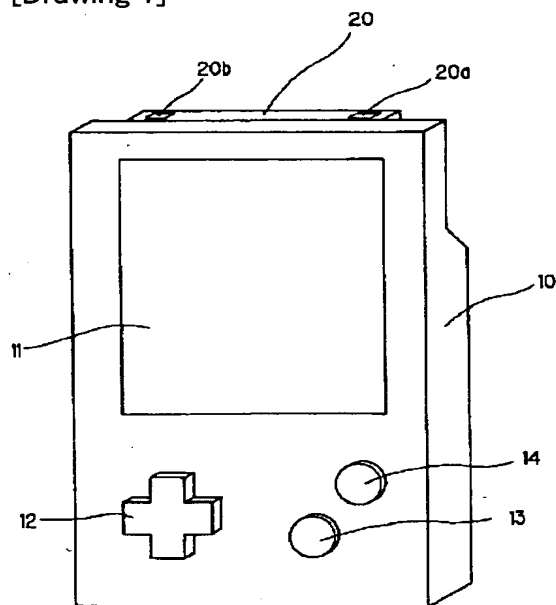
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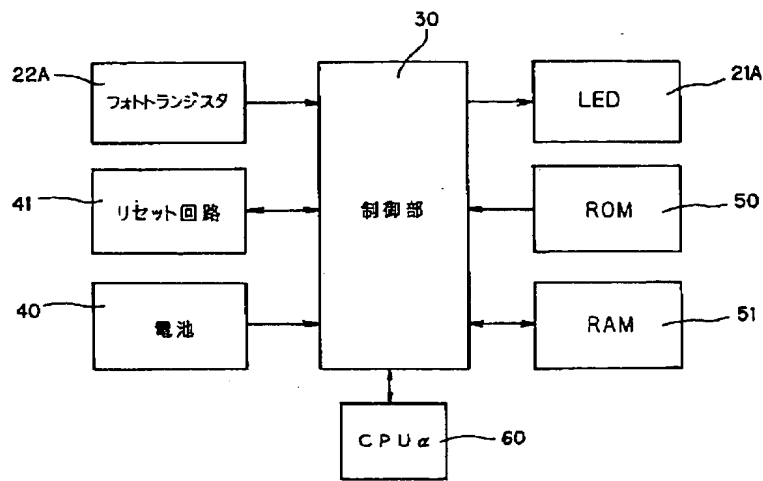
**DRAWINGS**

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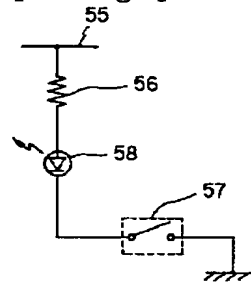
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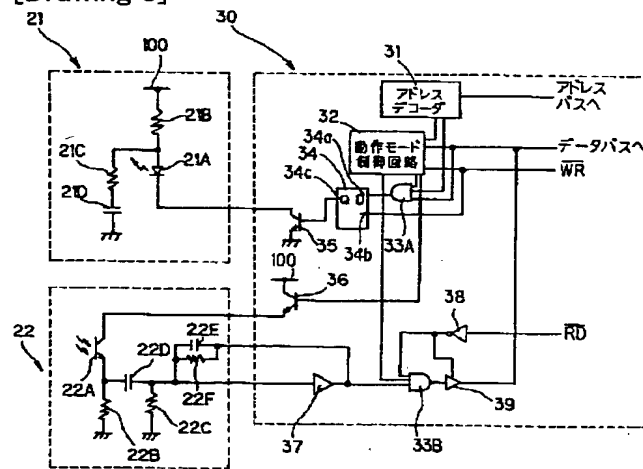
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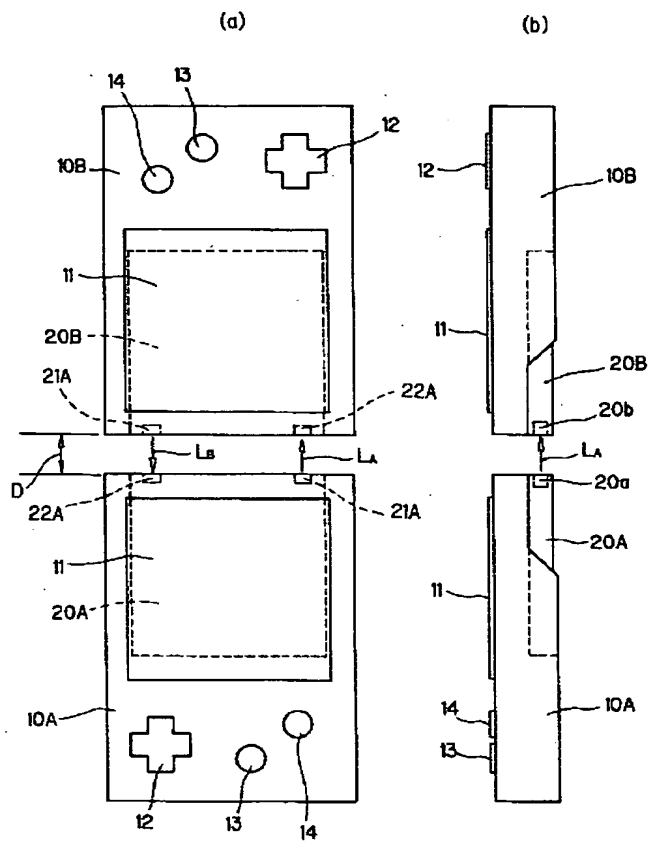
[Drawing 6]



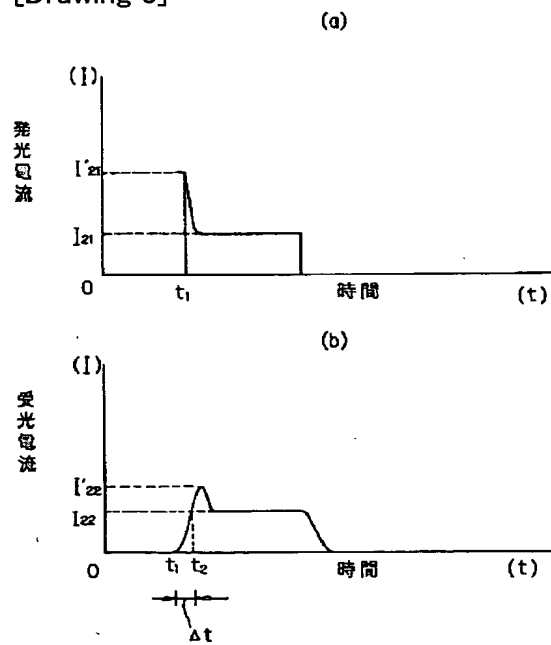
[Drawing 3]



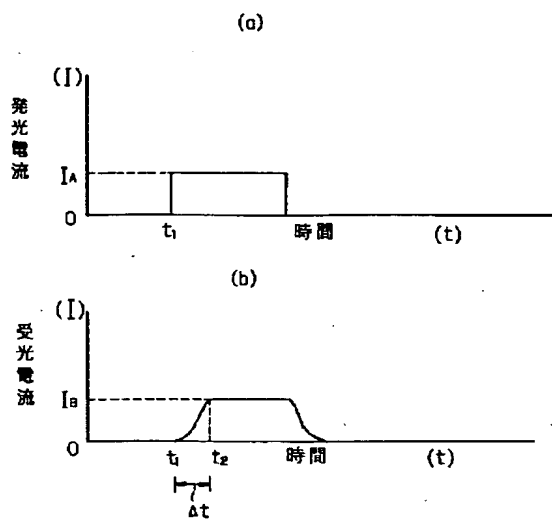
[Drawing 4]



[Drawing 5]



[Drawing 7]



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[Translation done.]